STAFF REPORT

STAFF FINDINGS: TIMETABLE FOR THE PHASEOUT OF MTBE FROM CALIFORNIA'S GASOLINE SUPPLY

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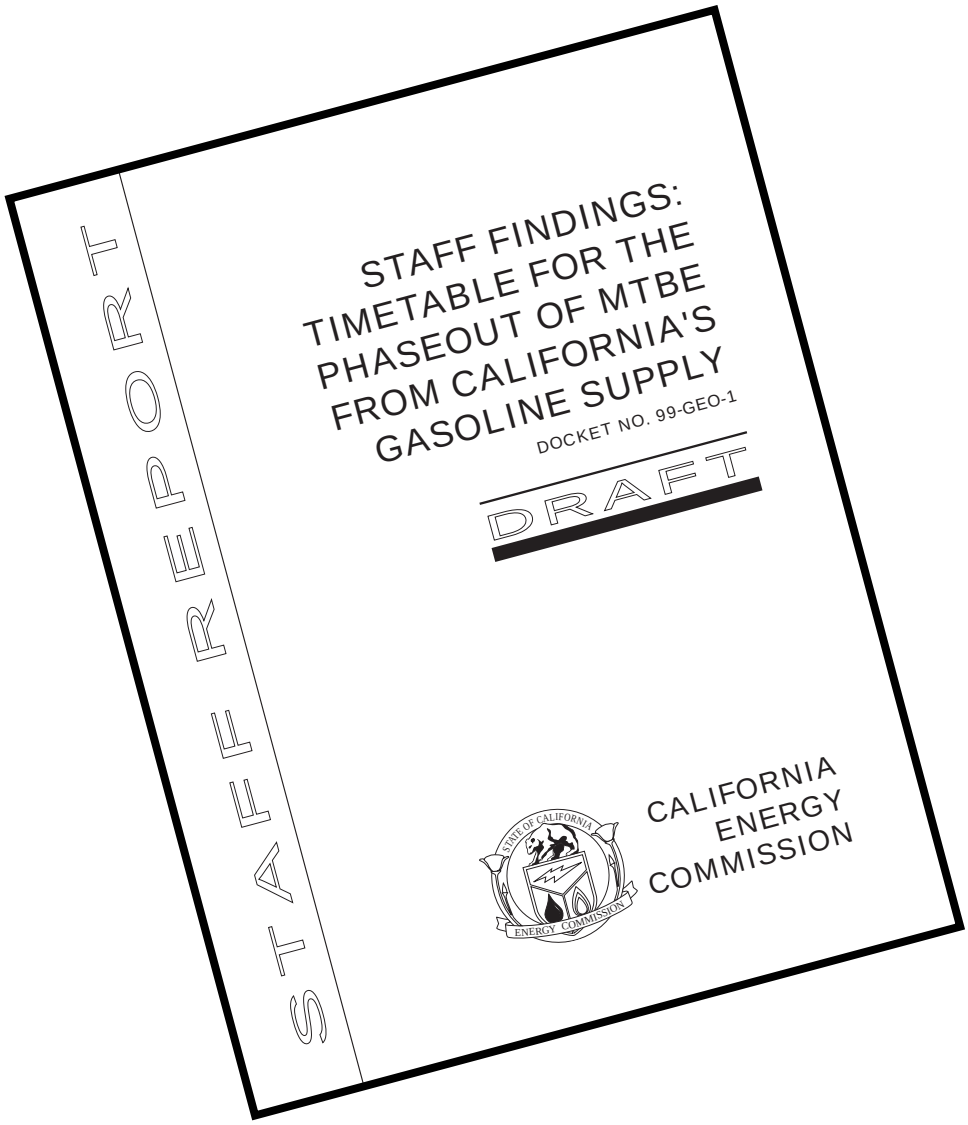

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Disclaimer

List Of Abbreviations

ARB	Air Resources Board
CaRFG2	California Reformulated Gasoline Phase 2
CaRFG3	California Reformulated Gasoline Phase 3
CEQA	California Environmental Quality Act
MTBE	Methyl Tertiary Butyl Ether
RFG	Reformulated Gasoline
SIP	State Implementation Plan
U S EPA	Environmental Protection

Introduction

In this report, the California Energy Commission and California Air Resources Board (ARB) staff discuss their draft findings for phasing out Methyl Tertiary Butyl Ether (MTBE) from the gasoline supply in California. This report is in response to Executive Order D-5-99 that was signed by Governor Gray Davis on March 25, 1999.

Organization of this Report

The report provides background information on the California gasoline industry, the refinery modifications needed to remove MTBE, including modifications to the gasoline distribution infrastructure. Other topics covered are the adequacy of ethanol supplies, project timelines, and removing MTBE before December 31, 2002 —the date specified in the Governor's executive order.

Background

The California ARB adopted the present reformulated gasoline (CaRFG2) regulations in the fall of 1991. These measures were undertaken in response to air quality concerns and actions taken by the United States Environmental Protection Agency (U.S. EPA). The refining industry in California and other areas of the United States reacted to the change in gasoline specifications by making significant modifications to their facilities.

Since the federal RFG regulations required the use of an oxygenate, refiners were compelled to make engineering and design decisions based on the use of a specific type of oxygenate. The refiners in California selected MTBE as their oxygenate of choice, mainly due to its availability, high octane value, ability to dilute less desirable gasoline properties (such as sulfur, aromatics, and olefins), and good distillation and volatility properties. Since the spring of 1996, MTBE has been used year-round as the predominant oxygenate in gasoline at approximately 11 percent by volume.

The federal Clean Air Act requires that areas in the United States that are designated either extreme or severe ozone nonattainment regions have federal RFG that contains a minimum amount of oxygen at all times. As a result, 30 percent of the gasoline consumed nationally has to meet federal RFG requirements. There are three such areas (or air basins) in California: Sacramento, South Coast (Los Angeles and surrounding areas), and San Diego. These regions collectively account for approximately 70 percent of the gasoline sold in the State or about 10 percent of the gasoline sold nationally.

The use of MTBE in gasoline, and subsequent leaks and spills associated with the distribution of gasoline, has resulted in the presence of MTBE at levels greater than the Secondary Maximum Contaminant Level of 5 parts per billion in a limited number of drinking water wells and surface water resources throughout California. To date, less

than 1 percent of all the public drinking water wells tested has revealed the presence of MTBE. Nevertheless, compared to typical gasoline blending components, MTBE is more soluble in water, is more costly to remove, and has the ability to travel farther and faster once it comes in contact with a groundwater aquifer. In drinking water, even at very low concentrations (such as 5 part per billion), MTBE can produce an unpleasant odor and taste.

The main concern associated with the continued use of MTBE is the potential to contaminate existing and future water sources. In response to this and other concerns, Governor Gray Davis signed Executive Order (D-5-99) on March 25, 1999.

As stipulated in item number 4 of the Executive Order, the Energy Commission was directed, in consultation with the ARB, to develop a timetable by July 1, 1999 to remove MTBE from gasoline at the earliest possible date, but no later than December 31, 2002.

In response to this Executive Order, the Energy Commission and ARB staff held meetings with each of the refining companies, petroleum product pipeline operators, environmental groups, permitting agencies, and ethanol industry representatives. The information obtained from discussions held in these meetings was used as part of the rationale for the findings presented in these draft staff findings. A public workshop will be held on June 18, 1999, to hear comments on the contents of this staff document.

MTBE Removal - Refinery Modifications

Finding: Removing MTBE from California's gasoline will require refiners to pursue a combination of compliance strategies that will involve the absence of oxygenates or the use of ethanol, or both. Also, the federal oxygenate mandate which impacts about 70 percent of California gasoline limits the flexibility refiners will have. But in either case, to produce similar volumes of reformulated gasoline meeting California specifications without MTBE, refiners will need to initiate and complete substantial modifications to selected process units at their facilities.

Eventually removing MTBE from California's gasoline will necessitate several changes at refineries as companies struggle to replace the gasoline volume and octane value that will be lost. Depending on the strategy pursued by each refiner, the projects undertaken will vary.

For those refiners that decide to use ethanol in place of MTBE, they will have to install equipment to adjust to the higher volatility of blending gasoline with ethanol. Refiners using ethanol will have to produce a base gasoline that has a lower volatility. This volatility is (approximately 5.5 to 5.8 pounds per square inch Reid vapor pressure) during the summer months. Gasoline blending components with high volatility, such as pentanes, will have to be removed so that the lower volatility base gasoline can be produced.

Since each gallon of ethanol contains more oxygen, when compared to MTBE, refiners do not have to blend as much ethanol in the gasoline to achieve the same oxygen level achieved with 11 percent by volume MTBE. The combination of having to remove pentanes and adding a lesser volume of ethanol means that refiners will not be able to completely displace the 11 percent volume lost with the removal of MTBE. The additional volume deficit will have to be made up by increasing other gasoline blending components such as alkylates. Refiners can accomplish this by either expanding alkylation capacity within their own facilities or by importing alkylates from outside California.

If flexibility from the federal oxygen requirement is provided, then for those refiners that choose to produce gasoline without the use of any oxygenates, some of the engineering approaches will be different. First, the refiners will not have to remove any pentanes to offset the higher volatility characteristics of ethanol. Refiners will have to replace the octane and volume lost from removing MTBE.

Few gasoline-blending components possess octane values greater than MTBE (110) or ethanol (115). The blending octane value for alkylates, in the range of 91 to 99, may be sufficient to meet the supplemental octane needs for both regular (87) and mid-grade (89) gasoline. But premium (92) gasoline blends are very difficult to make with the loss of MTBE's higher-octane value. Toluene (103) and isooctene (109) have higher octane values, but toluene is an aromatic and isooctene is an olefin, two gasoline properties that are limited by Phase 2 CaRFG specifications. A potential drawback could be the expense to produce higher octane alkylates.

MTBE Removal - Distribution Infrastructure Modifications

Finding: The modifications to the distribution infrastructure to allow for ethanol blending at all of the terminals will require up to two years to complete.

Refineries are not the only facilities that require modifications to remove MTBE. The majority of California's gasoline is transported by pipeline from the refineries to a network of storage terminals located throughout the state. Tanker trucks are then used to haul the gasoline from the terminals to service stations. For gasoline produced without ethanol, the distribution system would require little change. But if refiners choose or because they are required by a federal oxygen mandate to produce gasoline with ethanol, then modifications to certain portions of the distribution system will be necessary.

Ethanol is miscible in water (soluble), whereas gasoline components are generally not soluble in water. Water is usually present in storage tanks and pipelines, mostly due to contamination from rainwater and small amounts of water inherent in the refinery process system. Since petroleum products do not readily mix with water, the industry does not have much of a problem dealing with this issue. For ethanol this is not true.

Currently, refiners and pipeline operators are reluctant to ship gasoline blends containing ethanol through the pipeline distribution infrastructure because ethanol will adsorb water and associated contaminants present in the distribution system. The ensuing contaminated gasoline could cause problems for motorists. To address this problem, refiners and pipeline operators are likely to ship a base gasoline without ethanol to the terminals. The ethanol will then be combined with the base gasoline when the two components are blended into the tanker truck. Ethanol itself is usually delivered to the terminal by rail car or tanker truck, then stored in a separate storage tank.

Today, less than 30 percent of the terminals in California have the capability of dispensing gasoline containing ethanol. The remaining terminals will require the installation of a separate tank for the storage of the ethanol. In addition, many of the terminals will require the installation of special blending equipment so that ethanol can be mixed in the correct proportions while the tanker truck is loading. Transporting ethanol to the terminals will also require the construction of some additional rail connections, rail off-loading racks, tanker truck off-loading racks, or some combination. The permitting and construction required to upgrade all of the remaining California terminals to enable the distribution of gasoline containing ethanol will require up to two years to complete.

Brazil is the largest producer and consumer of ethanol in the world and has a great deal of experience moving ethanol through their distribution infrastructure. However, the products that Brazil sends by pipeline have different properties than the products moved by pipeline in California. Pipeline operators in California and other areas of the United States may possibly learn techniques that they can use to ship ethanol through the pipeline distribution system separately, without compromising the ethanol quality. If this change in pipeline operation can be accomplished, transportation costs could be reduced for delivering ethanol to the terminals.

MTBE Removal - Adequacy of Ethanol Supplies

Finding: Although California's demand for ethanol could be met if sufficient time were provided, availability of adequate ethanol supplies would become an issue if other areas of the country were also to ban MTBE while still requiring an oxygenate in gasoline.

Current ethanol production in the United States is averaging approximately 100,000 barrels per day. The majority of ethanol production facilities are located in the Midwest and use corn as a feedstock to produce the alcohol. If California were to use ethanol to replace MTBE, anywhere from 35,000 to 92,000 barrels per day would be required. Even though this volume is a rather large portion of today's total domestic production, adequate ethanol supplies could be brought to California if enough time were allowed to restart idle capacity, about 20,000 barrels per day, and to build new facilities. If other federal RFG areas in the U.S. need to switch from MTBE to ethanol, this could result in, the ethanol demand tripling. Even if only California switches to ethanol, this action

would require significant changes to the ethanol industry that could not be accomplished in one year.

MTBE Removal - Project Timelines

Finding: Project timelines for refinery modifications will require between 33 and 39 months to complete, assuming the CEQA review process is optimally accomplished in 12 months. Project timelines for distribution infrastructure modifications should be less than those of the refinery projects, mainly due to shorter construction periods.

Producing RFG for California without MTBE will require substantial modifications to refineries and the distribution infrastructure and an increase in ethanol production. Typical project timelines involve a number of discreet steps that must be accomplished to bring a project to a successful completion. The main steps include planning and engineering, approval of financing and acquisition of funds, permitting, purchase of major equipment, construction, and testing of the new and modified equipment.

Planning, engineering, funding, and equipment orders can take up to a year to complete. But there is room here to overlap some of these activities and possibly shorten this time period to six months. All permits associated with the refinery modifications are expected to undergo the California Environmental Quality Act (CEQA) review process. This step must be completed and the "permits to construct" issued before any construction begins.

Depending upon the size, complexity, and contentiousness of the various projects, the CEQA process could easily take one year or more to complete. Also, there is substantial uncertainty with regard to how this public process could be impacted by events beyond the control of the permit applicant. Thus, no guarantees can be made that this step could be shortened to some specific length of time. Once the permits have been obtained, the actual construction could be completed within 12 to 18 months. Testing the new process equipment would take approximately three months.

Ability to Advance the Timetable for Removal of MTBE

Finding: To ensure adequate supply and availability of gasoline for California consumers, the timetable for removal of MTBE from California's gasoline should not be advanced any earlier than the deadline of December 31, 2002.

As noted above, refiners will have to undertake major construction projects before they will be able to produce comparable volumes of RFG without MTBE. Planning and engineering for these projects will require up to six months to complete, followed by the permitting process, ordering of major process equipment, construction, and testing of the modified equipment. All of these activities will optimistically require, on average, a period of three years to complete.

Before implementing these projects, refiners have identified three important areas of uncertainty that need to be resolved: (1) the potential removal of the federal minimum oxygen requirement, (2) the viability of ethanol as a potential replacement for MTBE, and (3) the proposed Phase 3 reformulated gasoline (CaRFG3) specifications. Since the assessment of ethanol as an acceptable gasoline component will not be completed until December 1999 as well as the adoption of the specifications for Phase 3 RFG, refiners will most likely have to refrain from finalizing any MTBE phase-out plans until January of 2000 or later.

California's gasoline supply is in a fragile balance that can be subject to strong price increases if production capability or portions of the distribution infrastructure are even moderately impacted. The recent refinery problems and associated rapid increase in gasoline prices serve as a reminder of the important role of adequate production capability.

If the timetable for removal of MTBE from California's gasoline were to be advanced, not all of the refiners may have sufficient time to complete the necessary modifications to their facilities. The lack of production and an associated decrease in supply would likely lead to prices greater than experienced during the spring of 1999. To reduce the likelihood of such an occurrence, adequate time must be provided so that all the necessary modifications to the refineries, distribution infrastructures, and ethanol transportation and storage facilities can be completed. This approach will help to ensure that all gasoline, rather than a portion of the supply, can be produced without MTBE.

MTBE Removal Date - When and Where?

Findings: The removal date for MTBE of December 31, 2002 should apply to the production or importation point for finished gasoline and the bulk distribution facilities. With this, the service stations should not have to take any action to come into compliance.

Adequate time will be necessary for the new MTBE-free gasoline to work its way through the distribution system. The majority of gasoline storage tanks throughout the distribution system will have some of the old gasoline in the bottom of the tank when new delivery of gasoline arrives. The two different fuels get mixed together creating a third fuel with properties that are a mixture of the two. If the "old" gasoline happens to contain MTBE, the resulting mixture of the two fuels will also contain MTBE, but in a smaller concentration.

To ensure that all the MTBE is completely flushed from the various pipelines, storage tanks, and service stations, a certain period of time will have to pass before locations downstream from the refineries are MTBE-free. The ARB adopted a "staged" introduction strategy as part of their regulations for Phase 2 RFG. This approach allowed

an additional 90 days from the compliance date at the refinery for compliance at the service station. This strategy was quite successful because all the storage tanks were able to cycle through several different deliveries, effectively flushing out the old gasoline with the new fuel.

MTBE Removal Prior to December 31, 2002

The concept of removing MTBE from gasoline in California prior to December 31, 2002 was discussed during the course of meetings with the stakeholders. Basically, the idea manifests in three forms: a gradual phasing down of MTBE for the entire state; removing MTBE from specific geographic regions, removing MTBE from gasoline during the winter months.

Gradually Phasing -Down MTBE for the Entire State

Finding: A gradual phase-down of MTBE by 30 percent by the end of the first year is possible only if the federal minimum oxygen requirement is removed. In addition, refiners would not have adequate time to complete all the necessary modifications to permit a 60 percent phase-down of MTBE by the end of the second year.

This concept involves gradually removing MTBE from California gasoline over a period of years: 30 percent by the end of the first year, 60 percent by the end of the second year, and 100 percent by the end of the third year. The start time for the gradual phase-down concept is assumed to begin on January 1, 2000. In this case, staff expects that the entire gasoline supply would be in compliance by the end of the third year (December 31, 2002). But mandated gradual compliance by earlier dates is another matter.

Although this idea appears to have merit on the surface, a closer look reveals some hurdles that would be difficult to overcome. Assuming that the base comparison for reducing MTBE is that all of California's gasoline contains 11 percent by volume MTBE, then achieving a 30 percent reduction by the end of the first year would be possible only if the federal minimum oxygen requirement were to be eliminated. Removing the oxygen mandate would allow refiners to extend the practice of producing some portion of their gasoline without MTBE to other regions of the state outside of the San Francisco Bay Area.

If the federal oxygen mandate remains in effect, refiners would be required to use ethanol in approximately 70 percent of the state's gasoline. To use ethanol during the low volatility season (essentially April through October), substantial equipment modifications would be necessary, as discussed earlier. This type of refinery work would require a number of years, not just 12 months, to complete.

Achieving a 60 percent reduction in MTBE by the end of the second year would require substantial refinery modifications, regardless of whether the federal minimum oxygen mandate were to remain in effect or be removed. The 60 percent reduction would require refiners to make equipment changes that as discussed earlier cannot be done in less than three years. Finally, the additional record keeping to track gradual reduction goals would be a significant burden for both the industry and state agencies that enforce the gradual phase-down.

Removing MTBE From Specific Geographic Regions

Finding: Creating "MTBE-free zones" would require a number of years for the necessary refinery modifications to be completed and put the MTBE-free region at risk to supply disruptions and significant price spikes.

Another concept for accelerating the removal of MTBE from gasoline ahead of the December 31, 2002 deadline is that specific geographic regions of California be designated "MTBE-free zones." This type of designation would require that all grades of gasoline sold in the area not contain any MTBE.

Even though some of the refiners in the San Francisco Bay Area are currently producing the majority of their regular grade of gasoline without MTBE, expanding this practice to the rest of the gasoline sold in the region would require modifications to the refineries and changes to some portions of the distribution system. These projects would require a number of years to complete the planning, engineering, permitting, construction, and testing of the new process equipment before all grades and adequate volumes of complying gasoline could be supplied.

In addition, creating an "MTBE-free island" within the state will limit the options for suppliers to obtain alternative gasoline supplies when one or more of the refiners producing gasoline for the "MTBE-free zone" has an unanticipated production problem. Since the gasoline being sold in the "MTBE-free zone" will be unique, the availability of complying gasoline that could be used in the special region will be scarce. As a result, the recent price spike that occurred during the spring of 1999 could reoccur. But this time the severity of the price increase would be greater for two reasons. First, suppliers of gasoline to the "MTBE-free zone" would not be able to blend in additional volumes of MTBE to extend the gasoline supply. Second, the number of alternative sources of supply would be considerably less, limiting any relief that could be provided by importers or other producers in the state.

Most refiners in California produce gasoline for different market areas of the state. Rarely are these areas confined to a specific geographic region. Rather, over the course of a typical year, gasoline produced by a specific refiner could end up anywhere in the state. The flexibility for refiners to be able to send gasoline to any area of the state would be curtailed by the creation of an "MTBE-free zone," reducing the efficiency of the distribution system and increasing the costs for consumers.

Removing MTBE from Gasoline During the Winter Months

Finding: The seasonal removal of MTBE could not be accomplished without modifications to both the refineries and the distribution infrastructure. These projects would require a number of years to complete. However, absent a federal minimum oxygen mandate, seasonal use of ethanol could occur on a limited basis, where and when it meets the logistical, economic, and marketing plans of the various refiners.

A third concept for accelerating the removal of MTBE from gasoline in advance of the December 31, 2002 deadline is that refiners be required to remove MTBE from all grades of gasoline during the winter months.

If the federal minimum oxygen requirement remains in effect, refiners would be required to use ethanol as a substitute for MTBE. Even if adequate ethanol supplies could be secured in a relatively short period of time, the refiners would not be able to blend the ethanol at the terminals without making modifications to the distribution infrastructure. These modifications would take up to two years to complete the planning, engineering, permitting, and construction to enable all of the terminals to dispense gasoline blends containing ethanol. These additional modifications would require a substantial amount of time to complete.

Areas of Uncertainty

At the meetings, stakeholders raised several areas of uncertainty that will play a major role in decisions undertaken by refiners as they plan to remove MTBE. All of these issues, except for the federal minimum oxygen requirement, should be resolved by the end of this year. This resolution will provide refiners with additional certainty that should assist them with finalizing their engineering projects and allow them to initiate a chain of events that will eventually lead to the removal of MTBE from California's gasoline supply.

Federal Minimum Oxygen Requirement

Finding: Removing the federal minimum oxygen requirement would lead to an almost immediate reduction in the use of MTBE throughout the state to a point where at least 30 percent of the gasoline would be produced without MTBE. The use of MTBE would still continue until all modifications to the refineries had been completed.

Finding: If the federal minimum oxygen requirement is not removed, then refiners will continue using MTBE in quantities similar to today's until all modifications to the refineries are completed.

Federal law requires that regions in the United States that are either extreme or severe ozone nonattainment have federal RFG that contains a minimum amount of oxygen at all times. These areas have resulted in 30 percent of the gasoline consumed nationally having to meet federal RFG requirements. There are three such areas (or air basins) in California: Sacramento, South Coast (Los Angeles and surrounding areas), and San Diego. These regions collectively account for approximately 70 percent of the gasoline sold in the state or about 10 percent of the gasoline sold nationally. If this minimum oxygen requirement remains in effect, ethanol will be the most likely oxygenate to replace MTBE.

California RFG regulations allow refiners to produce complying fuel without any oxygenates. Three refiners in the San Francisco Bay Area are producing the majority of their regular grade of gasoline without adding any MTBE. This gasoline is marketed in the San Francisco region because the area is not an extreme or severe ozone nonattainment region. Because of the federal minimum oxygen requirement, refiners are unable to expand this practice into the Sacramento or Southern California federal RFG areas.

Viability of Ethanol

Finding: If ethanol in gasoline is found to pose a serious risk to people's health or our drinking water resources, then the December 31, 2002 date, removing MTBE would have to be re-evaluated because no other viable alternative to ethanol is known at this tine to be acceptable to industry, regulatory agencies, and health officials.

Finding: If ethanol is not a viable alternative to MTBE, refiners could produce sufficient volumes of reformulated gasoline by the December 31, 2002, deadline only if the federal minimum oxygen mandate were to be removed no later than January 31, 2000.

The Governor's Executive Order (D-5-99) also specifies that any substitute for MTBE be thoroughly assessed before it can be used in California's gasoline. Ethanol will be studied to see what the potential impacts might be for burning gasoline containing ethanol in a vehicle's engine and what problems could be associated with contamination of ground and surface water sources from leaks and spills of gasoline containing ethanol. Each of these studies is scheduled to be completed by December 31, 1999.

Phase 3 RFG Specifications

Finding: Even though the Phase 3 RFG regulations may require additional refinery modifications, the December 31, 2002 deadline should still allow for a sufficient period of time to complete the extra work, if the ARB were to use this same date for the introduction of their new regulation.

The Governor's Executive Order (D-5-99) also specifies that by December 1999 the ARB shall adopt California Phase 3 Reformulated Gasoline (CaRFG3) regulations that will provide additional flexibility to refiners to remove MTBE and maintain current emissions and air quality benefits while allowing compliance with the State Implementation Plan (SIP).

To comply with the Phase 3 RFG specifications, some additional refinery modifications may be necessary. Timing of the introduction of Phase 3 RFG could be important. Planning the introduction of Phase 3 RFG to coincide with the December 31, 2002 date to remove MTBE could afford planning and engineering advantages for refiners, as well as having the potential to optimize some of their capital expenditures.

Other Issues

Various stakeholders raised a number of important issues as "concerns." These matters were not necessarily related to or directly impact the timetable for removing MTBE, rather the importance is in the context of issues that will have to be resolved before MTBE is removed from California's gasoline. Staff intends to address at the public workshop such matters as: the definition of "MTBE-free" gasoline, fungibility of gasoline containing ethanol, potential for California to become a net importer of gasoline, and transportation concerns associated with the movement of large volumes of ethanol into the State.